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ABSTRACT

This document reports on the Videotape Classroom Study of the Third International Mathematics and Science Study (TIMSS). This exploratory research project focused on eighth-grade mathematics instruction in Germany, Japan, and the United States, videotaping one complete lesson in each sampled classroom during the 1994-95 school year. The organization of lessons, teachers' goals, and mathematical content is compared between the participant countries. (YDS)

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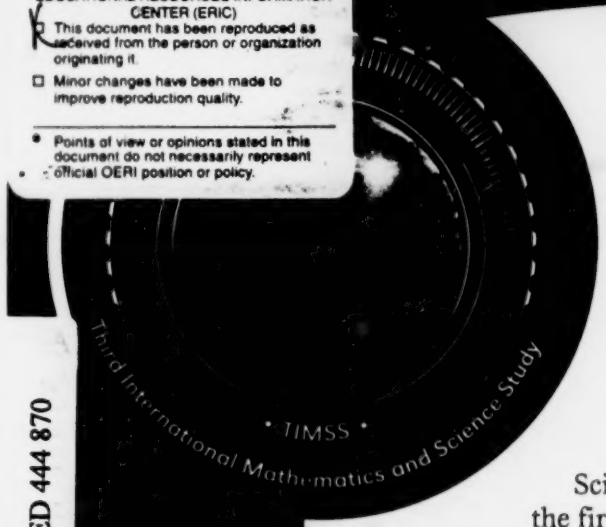

Highlights from the TIMSS Videotape Classroom Study

As part of the Third International Mathematics and Science Study (TIMSS), the Videotape Classroom Study is the first to collect videotaped records of classroom instruction, in any subject, from national probability samples. This exploratory research project focused on eighth-grade mathematics instruction in three countries—Germany, Japan, and the United States—videotaping one complete lesson in each sampled classroom at some point during the 1994–95 school year. This project was an effort to obtain rich, contextual information about what goes on inside eighth-grade mathematics classes in addition to the information collected through the TIMSS assessments and questionnaires, and to compare actual mathematics teaching methods in the United States and the two other countries.

In all, 231 eighth-grade mathematics classrooms were videotaped: 100 in Germany, 50 in Japan, and 81 in the United States. In addition, teachers were requested to complete a questionnaire that asked about the details of the videotaped lesson, about the typicality of the lesson, and their awareness of current ideas on mathematics learning and teaching, among other things. These classrooms were among those participating in the 1994–95 TIMSS assessments. The samples were designed as nationally representative of eighth-grade students in the three countries, although some minor deviations arose. In the Japanese sample, when there was more than one eighth-grade class in a school, the principal made the final decision of the classroom to be videotaped. In the United States, 40 of the original 109 sampled schools refused to participate. Twelve schools were used as replacements, resulting in a total of 81 schools in the final U.S. sample. The high refusal rate among the originally sampled U.S. schools should be kept in mind as a potential source of sampling bias.

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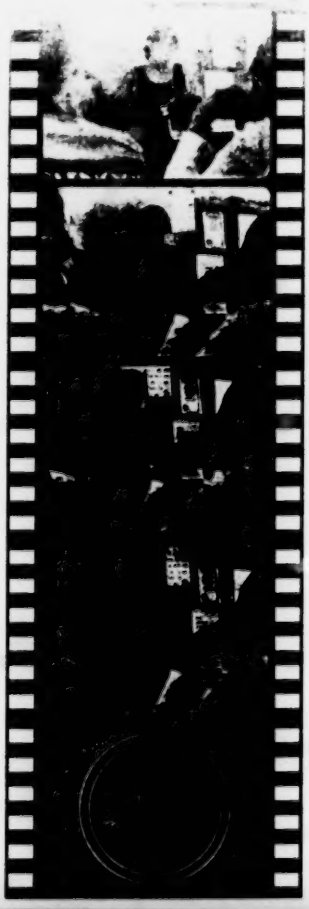
A detailed description of the technical aspects of the videotape study as well as the findings can be found in a research and development report published by the National Center for Education Statistics (NCES) entitled *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States* (NCES 1999–074). The findings presented in these highlights are taken from the larger report. Research and development reports are intended to share research that is developmental in nature; to share results that are on the cutting edge of methodological developments; and to participate in discussions of emerging issues of interest to researchers. These reports present results or discussion that do not reach definitive conclusions at this point in time, either because the data are tentative, the methodology is new and developing, or the topic is one on which there are divergent views. Therefore, the techniques and inferences made from the data are tentative and are subject to revision. In addition, caution should be exercised in generalizing to other subjects or grade levels.

Finally, it should be noted that discussion is limited to only those differences that are statistically significant. The omission of one or another nation in a discussion does not necessarily imply that there are not differences between the lessons examined.

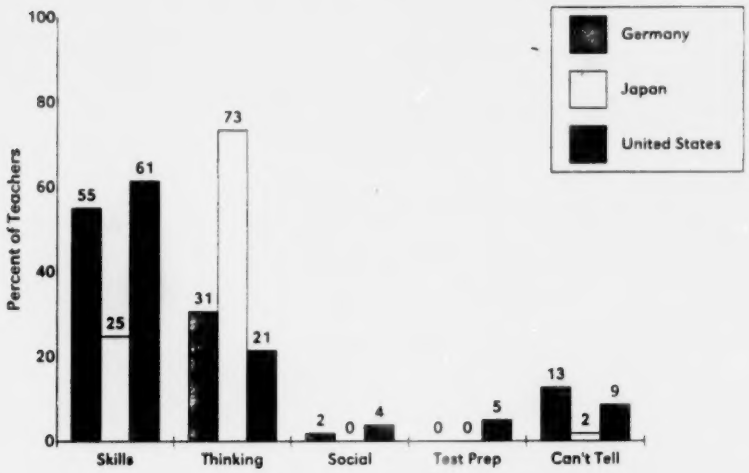
How lessons are organized and delivered



- A lesson's structure may be tied to a teacher's goal for that lesson. Based on results from the study, U.S. eighth-grade mathematics teachers' typical goal is to teach students how to do something, while Japanese teachers' typical goal is to help them understand mathematical concepts (see figure 1). When asked on the teacher questionnaire what main thing they wanted students to learn from the videotaped lesson, 55 percent of the German teachers and 61 percent of the U.S. teachers reported that skills were the main thing to be learned. Seventy-three percent of the Japanese teachers, on the other hand, reported that thinking was the main goal to be learned from their lessons.

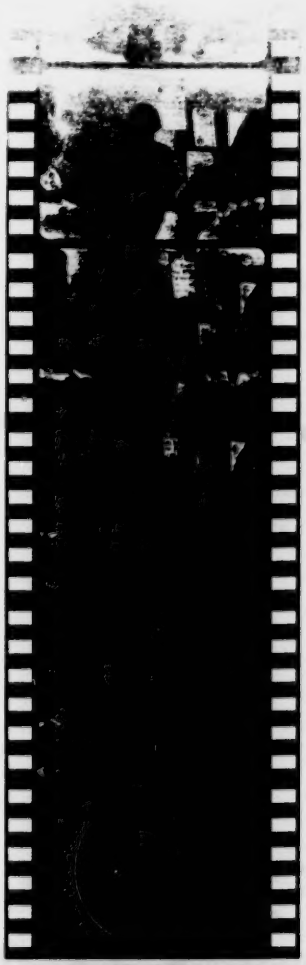
- The U.S. and German eighth-grade mathematics lessons tend to have two phases: an acquisition phase in which students are expected to learn how to solve particular types of problems, often through watching demonstrations by the teacher or their peers, and an application phase in which students are expected to practice what they have learned. In the Japanese lessons, the order of activity is generally reversed. Students try to solve problems on their own first, then engage in a period of teacher-directed discussion, often repeating this cycle several times.

Figure 1.—Teachers' responses, on the questionnaire, to the question, "What was the main thing you wanted students to learn from today's lesson?"



SOURCE: National Center for Education Statistics. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States.* Figure 12. Washington, DC: NCES.

- The U.S. eighth-grade mathematics lessons appear to be less coherent than the Japanese lessons based on the following information made evident by the video data: the U.S. lessons are more frequently interrupted than the Japanese lessons, from outside the classroom and within the U.S. lessons; contain more topics within the same lesson than the Japanese lessons; and the U.S. teachers are less likely to provide explicit links or connections between different parts of the same lesson than the Japanese teachers.



What kind of mathematics is presented

- The mathematical content of the U.S. lessons in the video sample is, on average, at the seventh-grade level by international standards, whereas in the Japanese lessons the average level is ninth grade. The content of the German lessons averages to the eighth-grade level.

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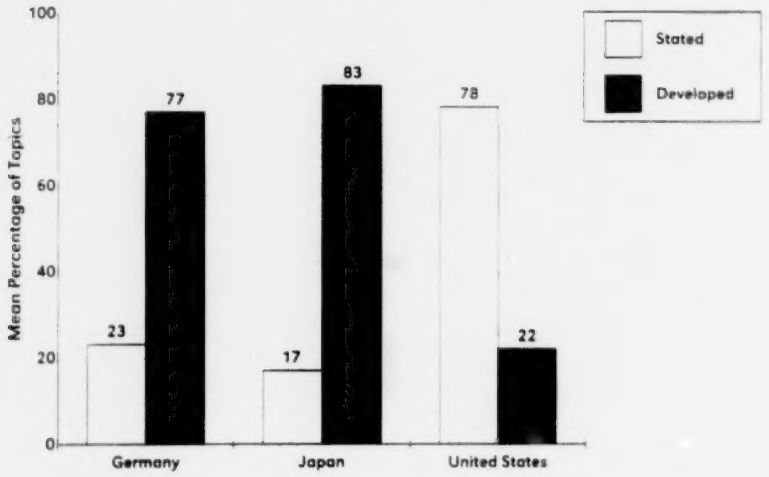
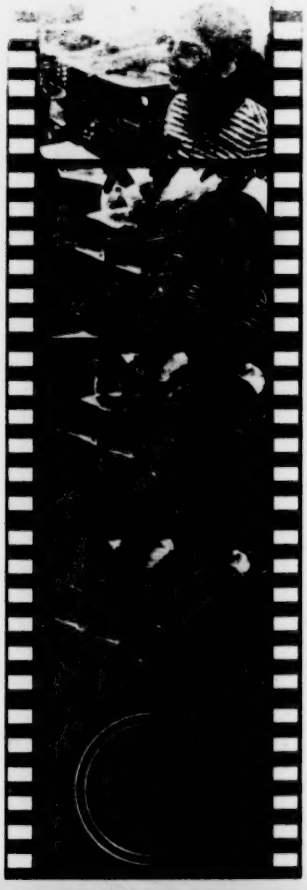
The video data showed that the delivery of the mathematical content also differs across countries. Most mathematics lessons include a mixture of concepts and applications of those concepts to solving problems. Concepts might simply be stated, as in "the Pythagorean theorem states that $a^2 + b^2 = c^2$," or they might be developed and derived over the course of the lesson. More than three-fourths of the topics presented in the German and Japanese lessons contained concepts that were developed, compared with about one-fifth of the topics presented in U.S. lessons (see figure 2).

Figure 2.—Average percentage of topics in eighth-grade mathematics lessons that contained concepts that were stated or developed



NOTE: The numbers in this graph differ slightly from those reported in Stigler, et al. (1999, page 52) due to rounding.

SOURCE: National Center for Education Statistics. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States.* Figure 18. Washington, DC: NCES.



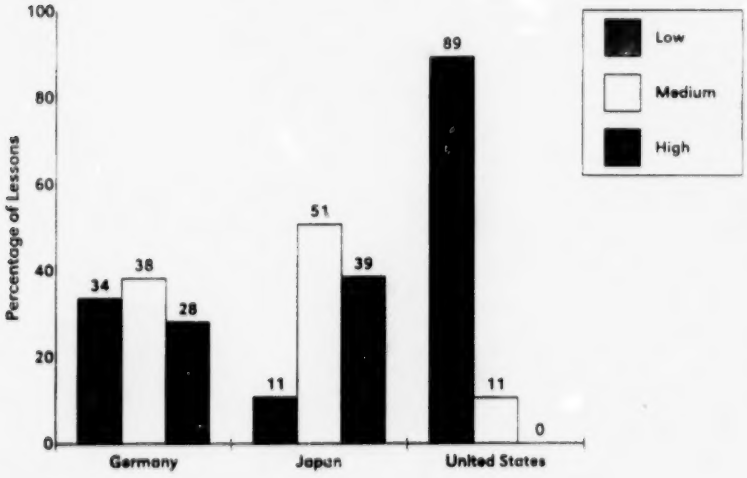
Constructing proofs is an important mathematical activity because it provides a reasoned method of verification based on the accepted assumptions and observations of the discipline. Analysis of the videotapes reveals that a greater percentage of the Japanese lessons include proofs than either the German or U.S. lessons. Indeed, 10 percent of the German lessons include proofs while 53 percent of the Japanese lessons include proofs. None of the U.S. lessons include proofs.

An independent group of U.S. college mathematics teachers analyzed the content of a subset of the videotaped lessons (30 lessons from each country, 15 algebra and 15 geometry). One analysis looked at

the level of choice students had in determining how to perform an assigned task. In the video data, for example, a teacher might demonstrate how to solve a problem and then ask students to apply the same method to a similar problem. This was coded as "task controlled" because students were asked to follow the procedure demonstrated by the teacher, and not to make their own decisions about how to approach the problem. In those cases where the video showed teachers asking students to see if they can think of another method for solving a problem, these were coded as "solver controlled." This is because the student had the freedom to decide which of several possible approaches to take. Seventeen percent of the Japanese lessons and 48 percent of the German lessons contained all task-controlled tasks, compared with 83 percent of the U.S. lessons.

The same group of U.S. college mathematics teachers also evaluated the quality of the mathematical content in a sample of the video lessons. Their judgments were based on a detailed written description of the content that was altered for each lesson to disguise the country of origin (deleting, for example, references to currency names). They completed a number of in-depth analyses, one of which involved making global judgments of the quality of each lesson's content on a three-point scale: low, medium, or high. Whereas 39 percent of the Japanese and 28 percent of the German lessons received the highest rating, none of the U.S. lessons received the highest rating (see figure 3). Eighty-nine percent of the U.S. lessons received the lowest rating, compared with 11 percent of the Japanese lessons.

Figure 3.—Percentage of lessons rated as having low, medium, and high quality of mathematical content



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: National Center for Education Statistics. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States.* Figure 34. Washington, DC: NCES.

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The kind of mathematical thinking in which students are engaged

- When the videotaped lessons were examined for the kind of work students engage in during the lessons, there is a resemblance between the U.S. and Germany, with Japan looking different. Three types of work were coded: practicing routine procedures, applying concepts in new situations, and inventing new solution methods/thinking. Ninety-six percent of student working time in the U.S. lessons and 89 percent in the German lessons is spent in practicing routine procedures compared with 41 percent in the Japanese lessons. Forty-four percent of student working time in the Japanese lessons is spent inventing new solutions/thinking compared with 1 percent in the U.S. lessons and 4 percent in the German lessons.

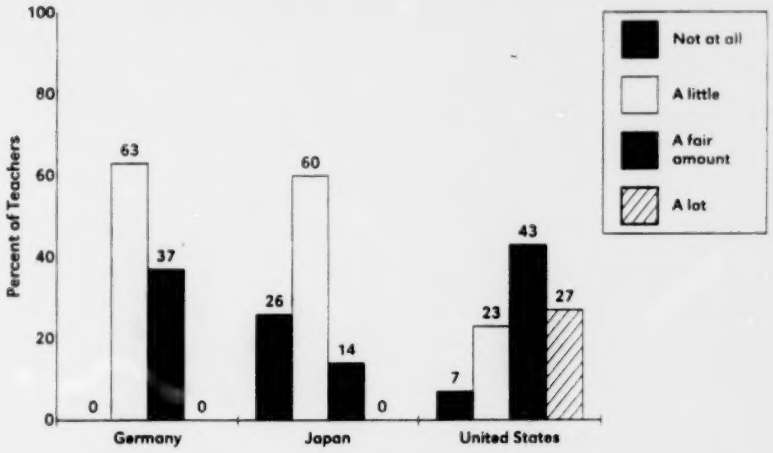
- The questions that teachers ask students can generate much of the mathematical content that is discussed in a lesson. Teacher questions related to mathematics, mathematical operations, or the lesson itself were coded as being of three types: yes/no questions, name/state questions, or describe/explain questions. Based on an analysis of a sample of utterances from each lesson, the German teachers asked significantly more name/state questions than did either the Japanese or U.S. teachers; the U.S. teachers asked significantly more yes/no questions than did the Japanese teachers; and the German and Japanese teachers asked significantly more describe/explain questions than did the U.S. teachers.

How teachers relate to current reform ideas

- Bearing in mind that "current ideas" may differ among Germany, Japan, and the United States, the teachers were asked how aware they are of current ideas about the teaching and learning of mathematics. Thirty-nine percent of the U.S. teachers reported being "very aware" of current ideas, while 5 percent of the Japanese teachers indicated this level of awareness.

- When asked the extent to which the videotaped lesson was in accord with current ideas about teaching and learning mathematics, 27 percent of the U.S. teachers responded "a lot," and 70 percent responded either "a lot" or "a fair amount." None of the German or Japanese teachers responded "a lot," and 37 percent of the German teachers and 14 percent of the Japanese teachers responded "a fair amount" (see figure 4).

Figure 4.—Teachers' perceptions regarding the extent to which the videotaped lesson was in accord with current ideas about the teaching and learning of mathematics



SOURCE: National Center for Education Statistics. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States.* Figure 83. Washington, DC: NCES.

When the U.S. teachers were asked to identify specific moments in the videotaped lesson that exemplified current ideas about teaching and learning mathematics, 38 percent of the U.S. teachers pointed to parts of the lesson that focused on the application of mathematics to daily life or involved the use of physical or manipulative representations of mathematical concepts. Furthermore, 31 percent of the U.S. teachers mentioned cooperative learning in their response. Finally, 19 percent of the U.S. teachers mentioned a focus on thinking—conceptual understanding, a focus on process over product, or a focus on problem solving—as evidence.

SOURCE: Stigler, J.W., Gonzales, P., Kawanaka, T., Knoll, S., and Serrano, A. (1999). *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States* (NCES 1999-074). Washington, DC: National Center for Education Statistics.

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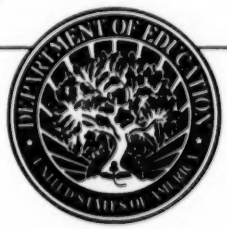

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